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(54) **COMMODITY RECOGNITION APPARATUS AND COMMODITY RECOGNITION METHOD**

(71) Applicant: **TOSHIBA TEC KABUSHIKI KAISHA**, Shinagawa-ku, Tokyo (JP)

(72) Inventors: **Hiroshi Sugasawa**, Miyagi-ken (JP); **Hidehiro Naito**, Shizuoka-ken (JP)

(73) Assignee: **Toshiba Tec Kabushiki Kaisha**, Tokyo (JP)

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CPC ***G06K 9/00624*** (2013.01); ***G06K 9/00671*** (2013.01); *G06K 2209/17* (2013.01)

(58) **Field of Classification Search**
USPC 382/100, 103, 108, 110, 112, 181–231, 382/291, 292, 301, 321; 348/89, 135, 143
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,687,107	A *	8/1987	Brown et al.	209/556
5,845,002	A *	12/1998	Heck et al.	382/110
6,005,959	A *	12/1999	Mohan et al.	382/110
6,535,637	B1 *	3/2003	Wootton et al.	382/190
7,974,472	B2 *	7/2011	Zou et al.	382/187
8,406,475	B2 *	3/2013	Bernard et al.	382/110
8,577,145	B2 *	11/2013	Panetta	382/181
8,712,163	B1 *	4/2014	Osheroff	382/195
8,727,208	B2 *	5/2014	Poisner	235/375
8,861,816	B2 *	10/2014	Lang et al.	382/128
2010/0232640	A1 *	9/2010	Friend et al.	382/100
2014/0079326	A1 *	3/2014	Ito et al.	382/224

FOREIGN PATENT DOCUMENTS

JP	11-232296	8/1999
JP	2001-064160	3/2001
JP	2004-167158	6/2004
JP	2007-172077	7/2007
JP	2008-134731	6/2008
JP	2010-218109	9/2010
JP	2011-002989	1/2011

OTHER PUBLICATIONS

Japanese Office Action for Japanese Patent Application No. 2012-193072 mailed on Jul. 29, 2014.

* cited by examiner

Primary Examiner — Anand Bhatnagar
(74) *Attorney, Agent, or Firm* — Amin, Turocy & Watson, LLP

(57) **ABSTRACT**

A commodity recognition apparatus detects an appearance feature amount of a commodity included in an image captured by an image capturing unit, extracts a candidate of the commodity included in the captured image by comparing the data of the appearance feature amount with the feature amount data in a recognition dictionary file, recognizes a character string included in the image captured by the image capturing unit, and determines a commodity of a recognition target according to the recognized character string and the extracted candidate of the commodity.

10 Claims, 12 Drawing Sheets

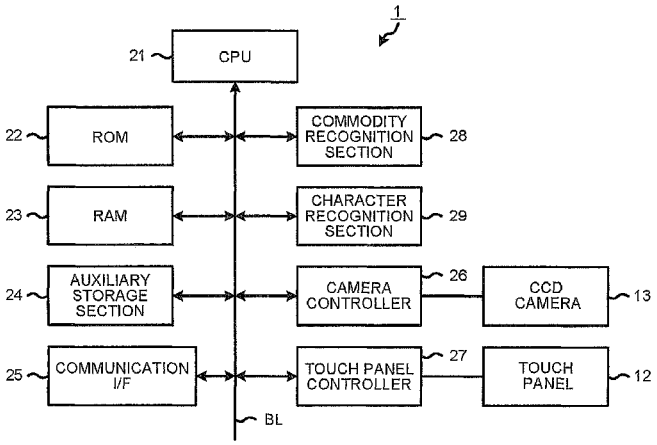


FIG.1

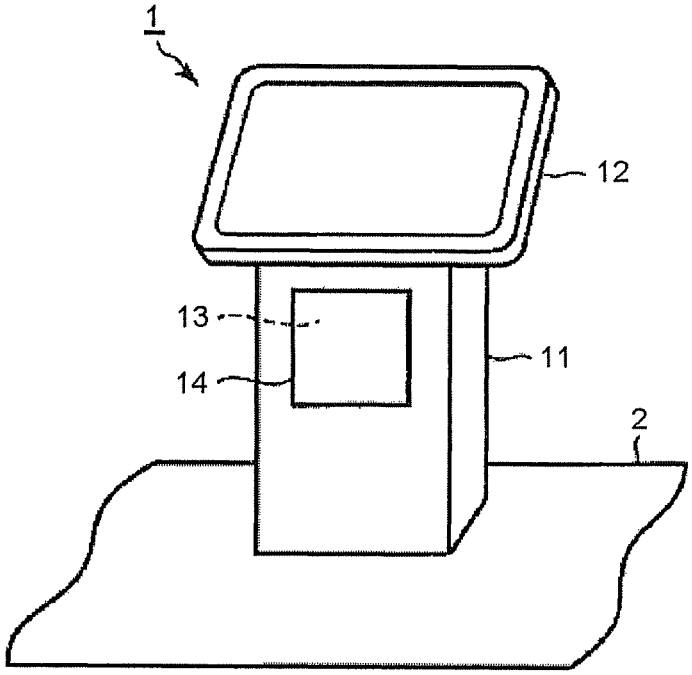


FIG.2

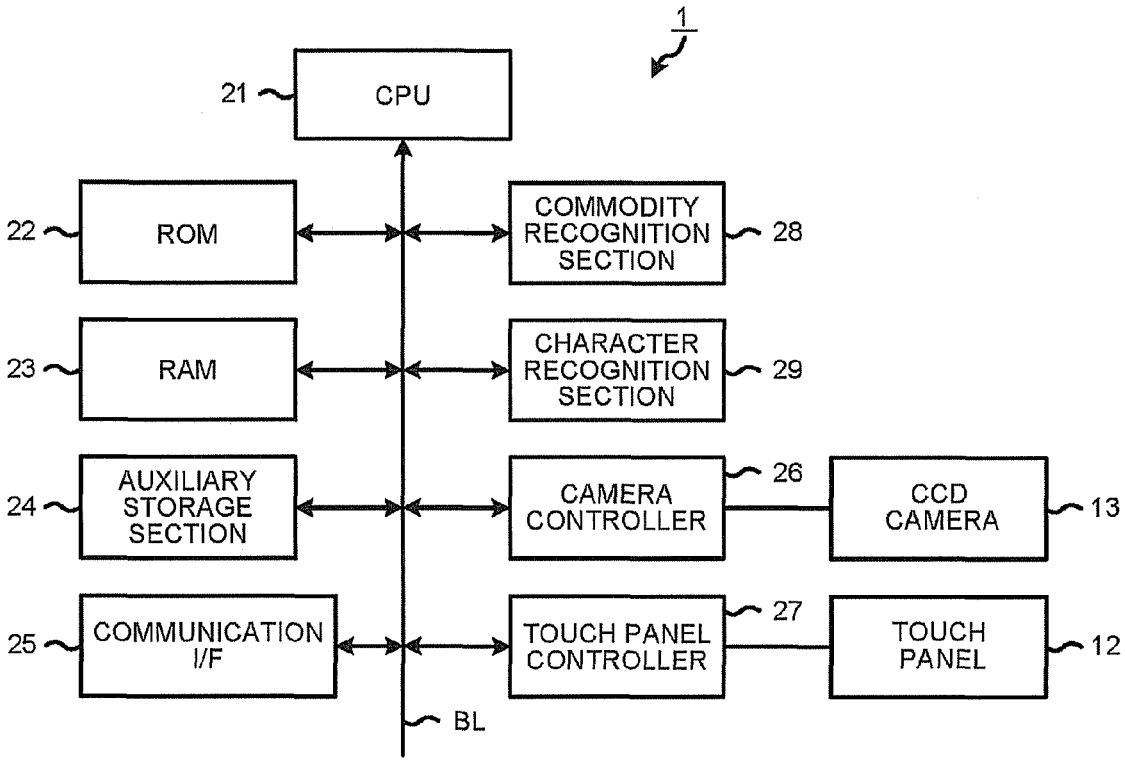

1
21
CPU
22
ROM
23
RAM
24
AUXILIARY STORAGE SECTION
25
COMMUNICATION I/F
BL
COMMODITY RECOGNITION SECTION
28
CHARACTER RECOGNITION SECTION
29
CAMERA CONTROLLER
26
CCD CAMERA
13
TOUCH PANEL CONTROLLER
27
TOUCH PANEL
12

FIG.3

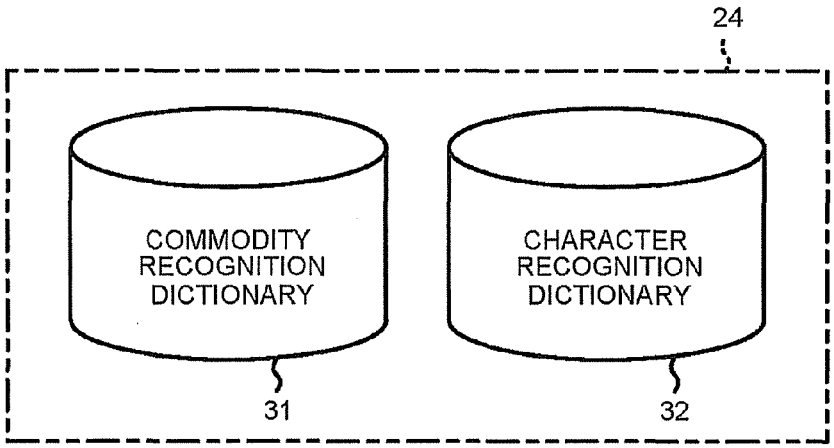

24
COMMODITY RECOGNITION DICTIONARY
31
CHARACTER RECOGNITION DICTIONARY
32

FIG.4

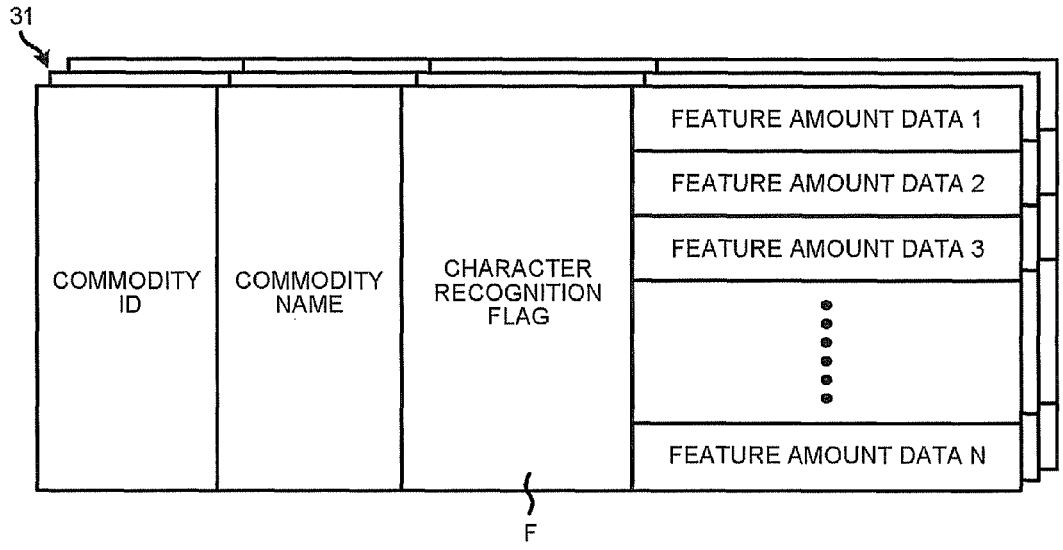

31
COMMODITY ID
COMMODITY NAME
CHARACTER RECOGNITION FLAG
FEATURE AMOUNT DATA 1
FEATURE AMOUNT DATA 2
FEATURE AMOUNT DATA 3
FEATURE AMOUNT DATA N
F

FIG.5

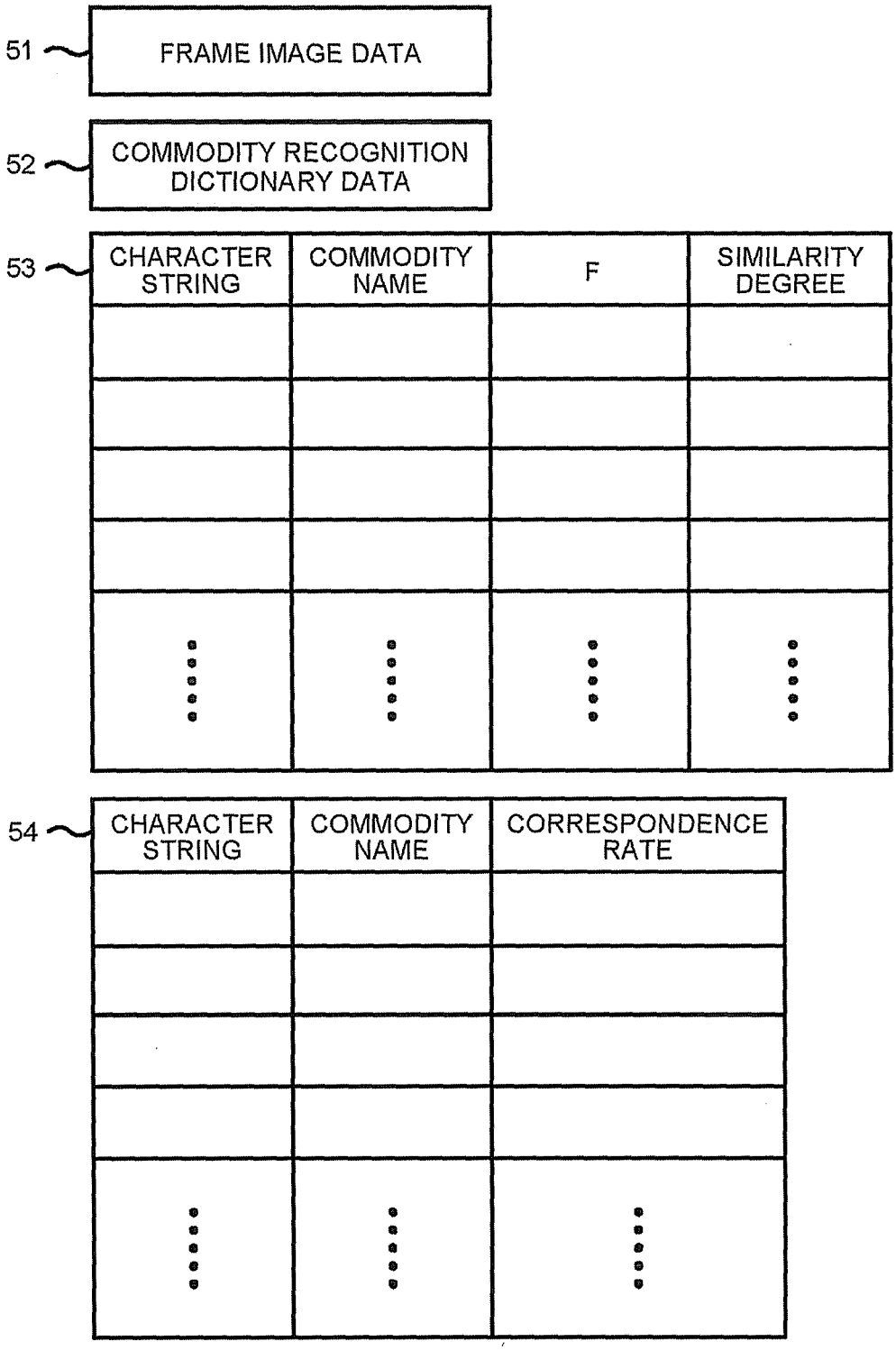

51
FRAME IMAGE DATA
52
COMMODITY RECOGNITION DICTIONARY DATA
53
CHARACTER STRING
COMMODITY NAME
F
SIMILARITY DEGREE
54
CHARACTER STRING
COMMODITY NAME
CORRESPONDENCE RATE

FIG.6

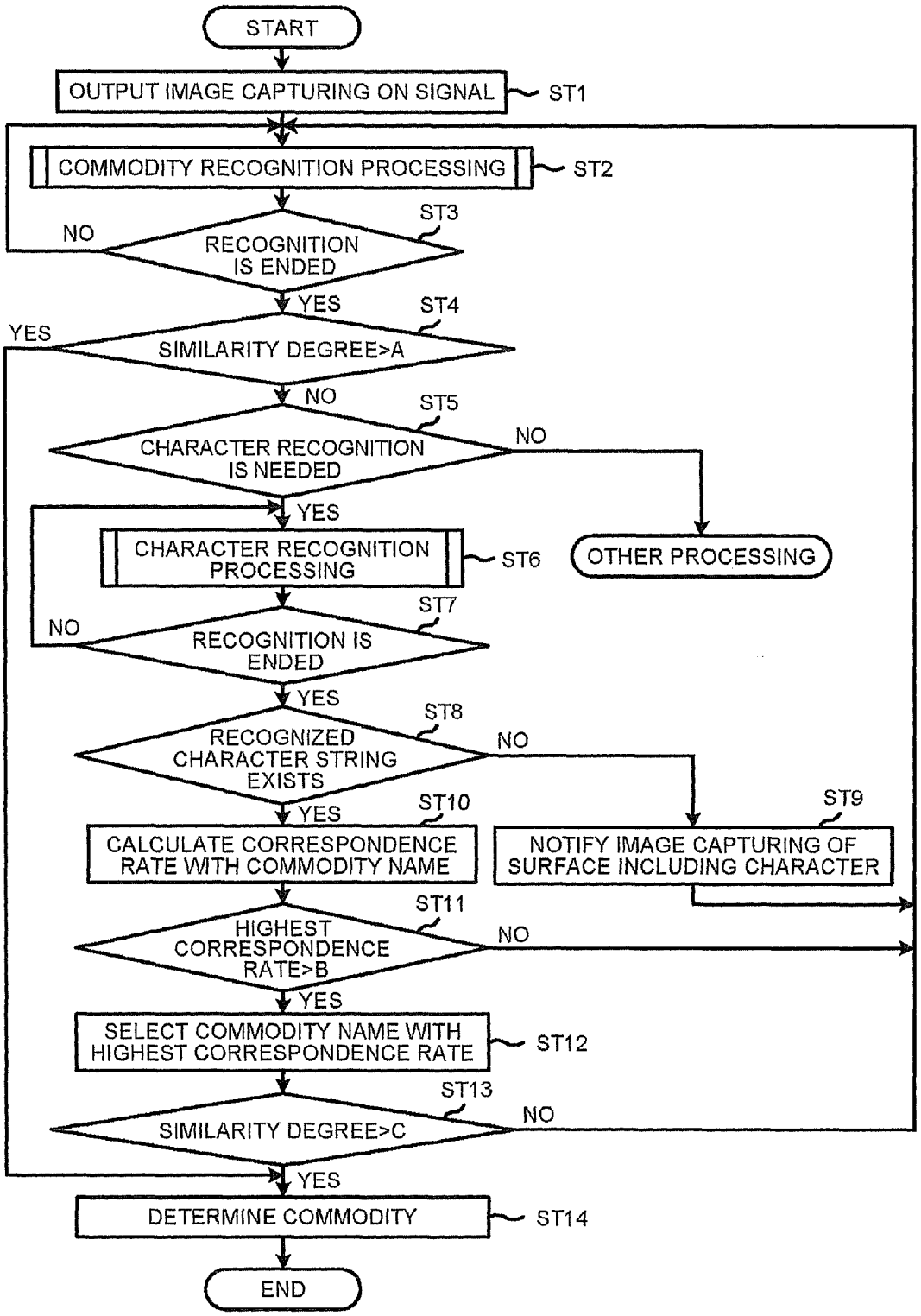

START
OUTPUT IMAGE CAPTURING ON SIGNAL
ST1
COMMODITY RECOGNITION PROCESSING
ST2
ST3
NO
RECOGNITION IS ENDED
YES
ST4
YES
SIMILARITY DEGREE>A
NO
ST5
CHARACTER RECOGNITION IS NEEDED
NO
YES
CHARACTER RECOGNITION PROCESSING
ST6
OTHER PROCESSING
ST7
NO
RECOGNITION IS ENDED
YES
ST8
RECOGNIZED CHARACTER STRING EXISTS
NO
YES
ST10
CALCULATE CORRESPONDENCE RATE WITH COMMODITY NAME
ST9
NOTIFY IMAGE CAPTURING OF SURFACE INCLUDING CHARACTER
ST11
HIGHEST CORRESPONDENCE RATE>B
NO
YES
SELECT COMMODITY NAME WITH HIGHEST CORRESPONDENCE RATE
ST12
ST13
SIMILARITY DEGREE>C
NO
YES
DETERMINE COMMODITY
ST14
END

FIG.7

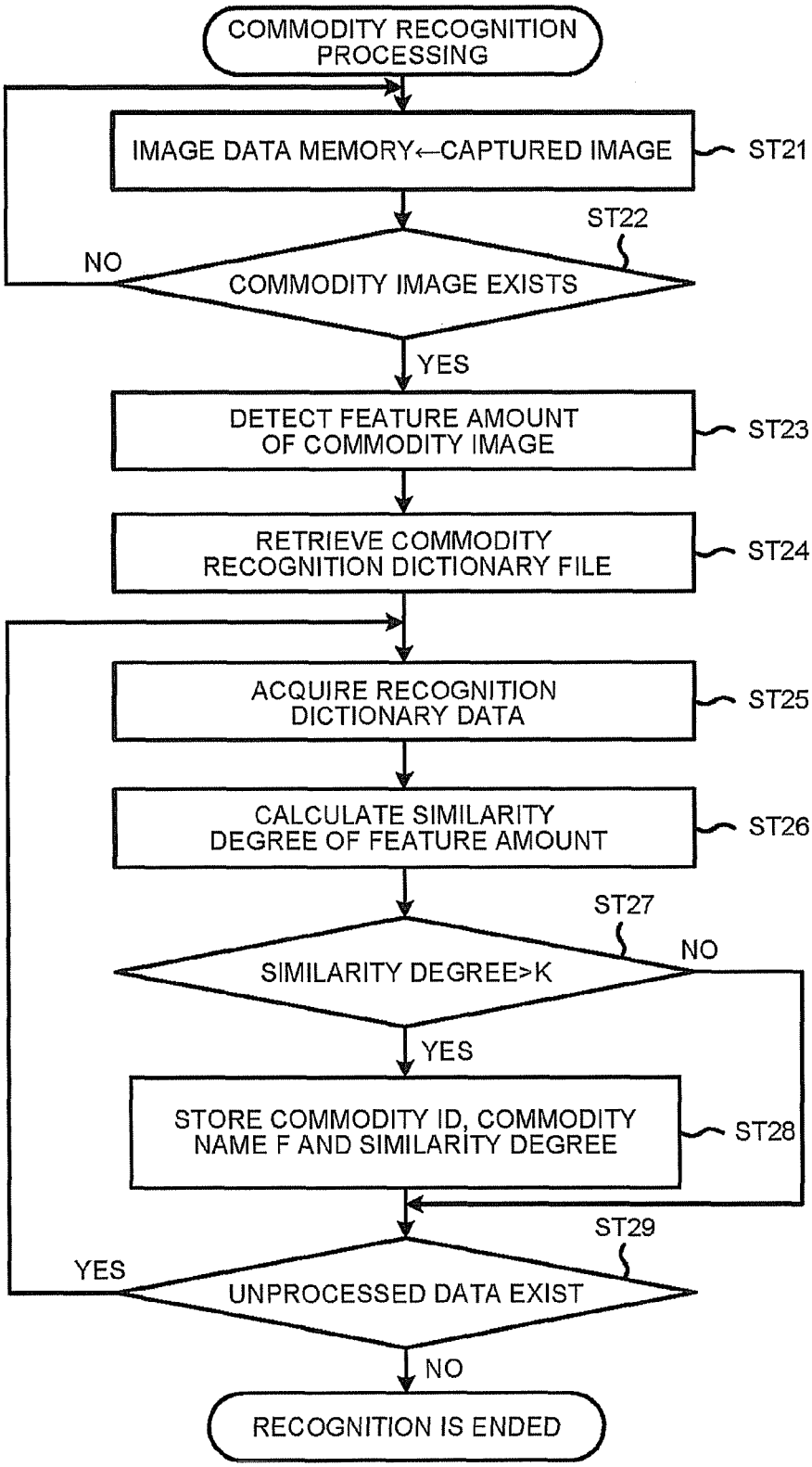

COMMODITY RECOGNITION PROCESSING
IMAGE DATA MEMORY←CAPTURED IMAGE
ST21
ST22
NO
COMMODITY IMAGE EXISTS
YES
DETECT FEATURE AMOUNT OF COMMODITY IMAGE
ST23
RETRIEVE COMMODITY RECOGNITION DICTIONARY FILE
ST24
ACQUIRE RECOGNITION DICTIONARY DATA
ST25
CALCULATE SIMILARITY DEGREE OF FEATURE AMOUNT
ST26
ST27
SIMILARITY DEGREE>K
NO
YES
STORE COMMODITY ID, COMMODITY NAME F AND SIMILARITY DEGREE
ST28
ST29
YES
UNPROCESSED DATA EXIST
NO
RECOGNITION IS ENDED

FIG.8

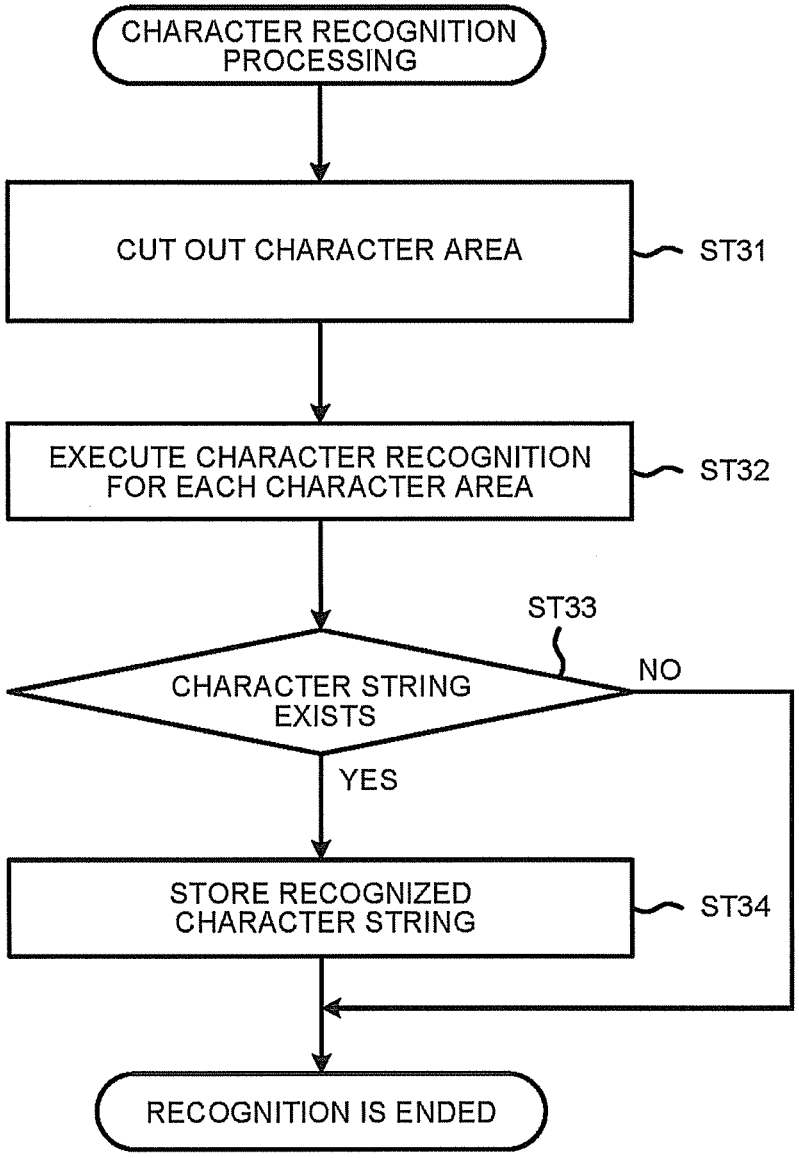

CHARACTER RECOGNITION PROCESSING
CUT OUT CHARACTER AREA
ST31
EXECUTE CHARACTER RECOGNITION FOR EACH CHARACTER AREA
ST32
ST33
CHARACTER STRING EXISTS
NO
YES
STORE RECOGNIZED CHARACTER STRING
ST34
RECOGNITION IS ENDED

FIG.9

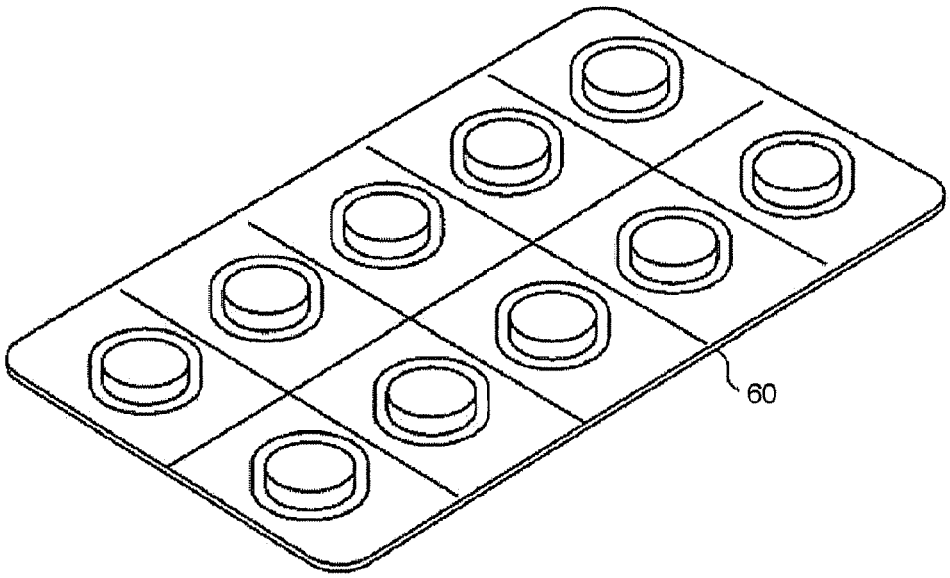


FIG.10

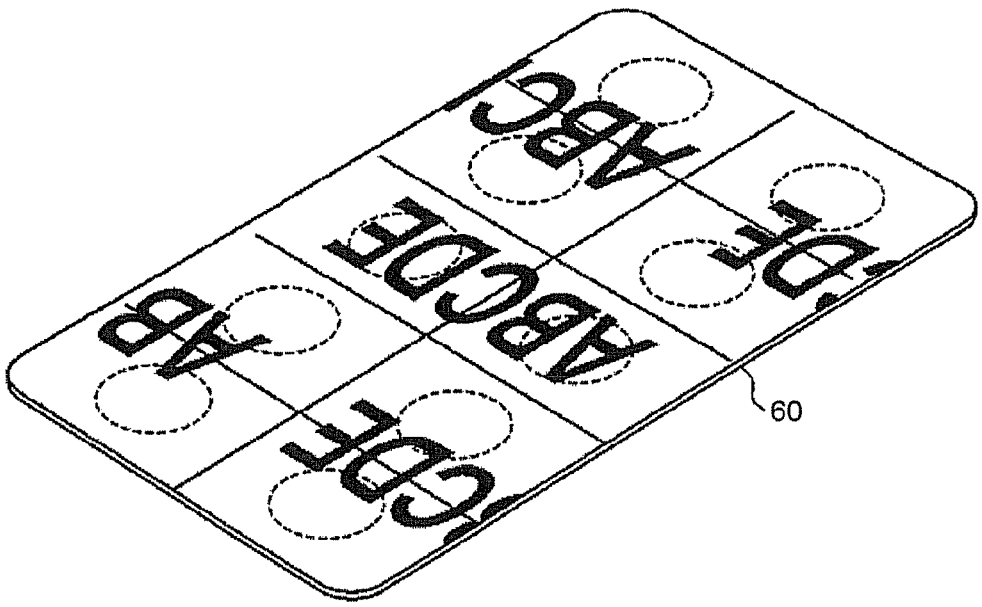


FIG.11

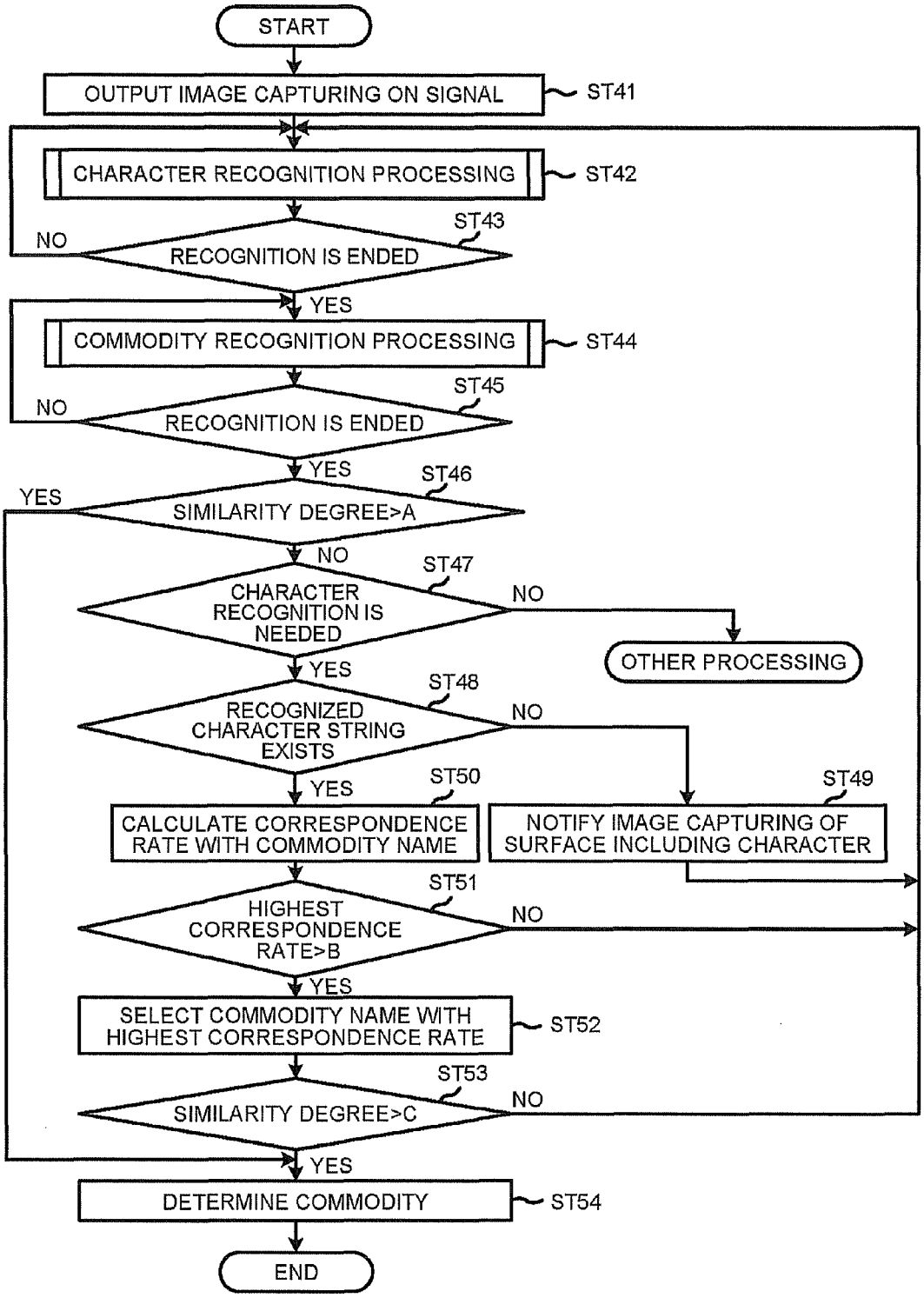

START
OUTPUT IMAGE CAPTURING ON SIGNAL
ST41
CHARACTER RECOGNITION PROCESSING
ST42
ST43
NO
RECOGNITION IS ENDED
YES
COMMODITY RECOGNITION PROCESSING
ST44
ST45
NO
RECOGNITION IS ENDED
YES
ST46
YES
SIMILARITY DEGREE>A
NO
ST47
CHARACTER RECOGNITION IS NEEDED
NO
OTHER PROCESSING
YES
ST48
RECOGNIZED CHARACTER STRING EXISTS
NO
YES
ST50
CALCULATE CORRESPONDENCE RATE WITH COMMODITY NAME
ST49
NOTIFY IMAGE CAPTURING OF SURFACE INCLUDING CHARACTER
ST51
HIGHEST CORRESPONDENCE RATE>B
NO
YES
SELECT COMMODITY NAME WITH HIGHEST CORRESPONDENCE RATE
ST52
ST53
SIMILARITY DEGREE>C
NO
YES
DETERMINE COMMODITY
ST54
END

FIG.12

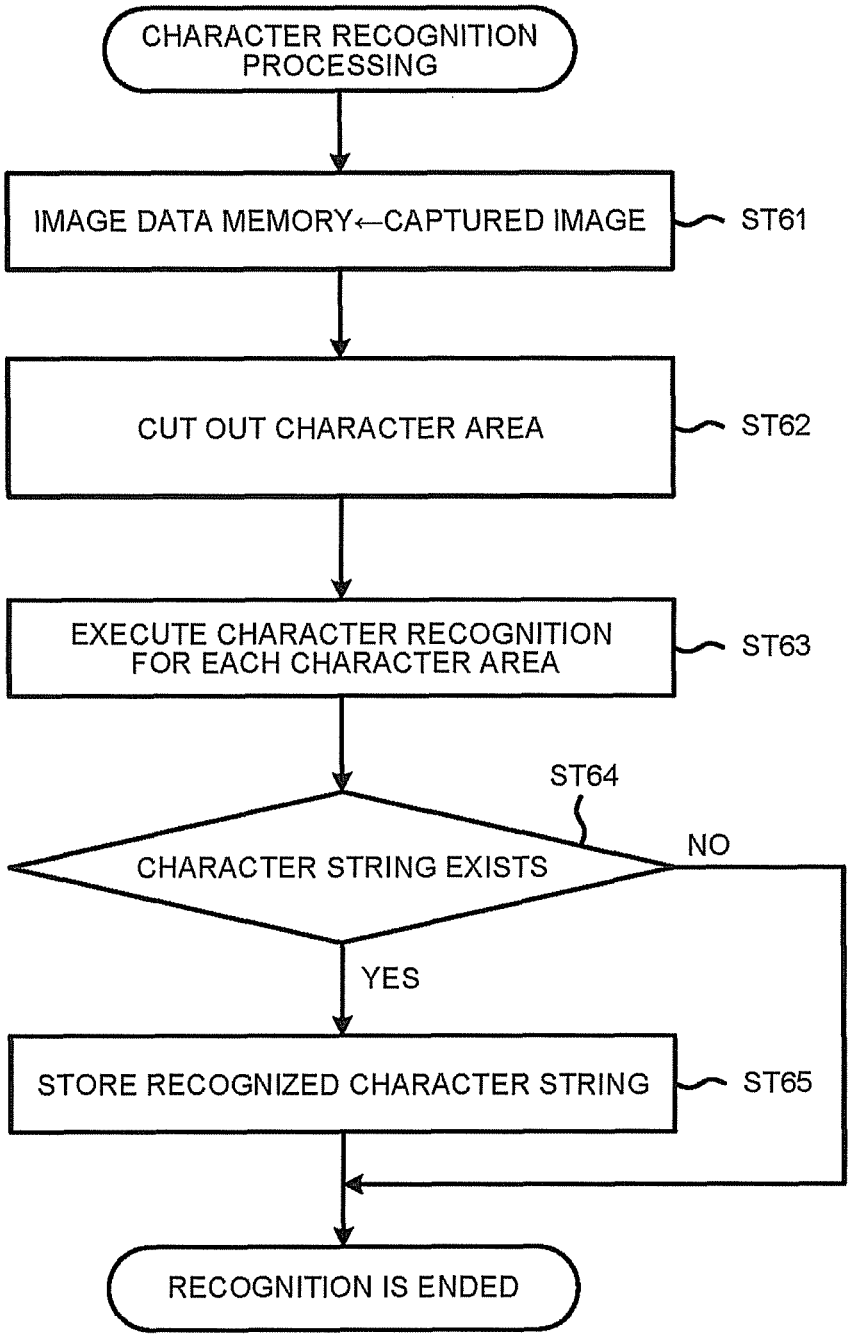
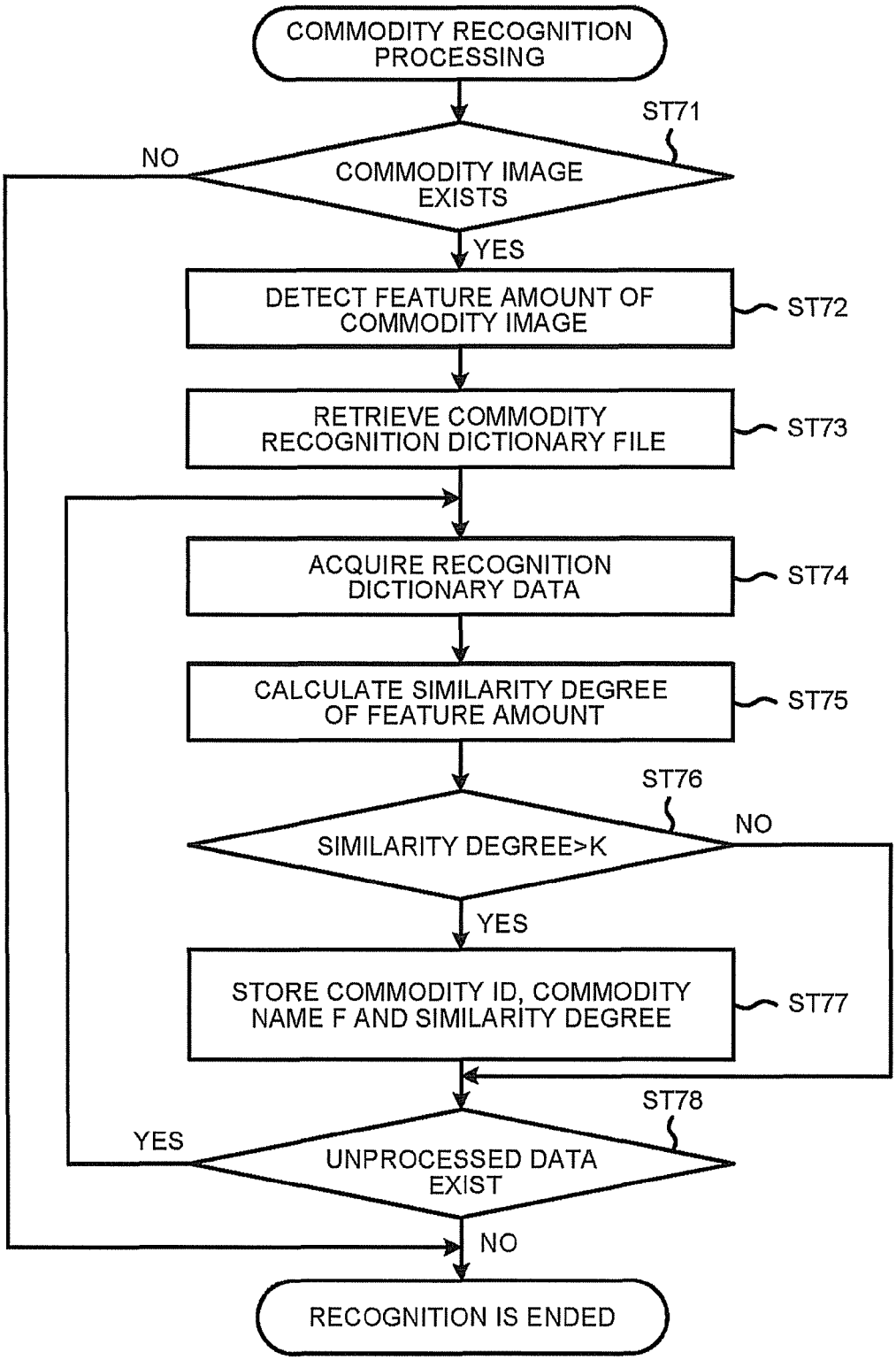

CHARACTER RECOGNITION PROCESSING
IMAGE DATA MEMORY←CAPTURED IMAGE
ST61
CUT OUT CHARACTER AREA
ST62
EXECUTE CHARACTER RECOGNITION FOR EACH CHARACTER AREA
ST63
ST64
CHARACTER STRING EXISTS
NO
YES
STORE RECOGNIZED CHARACTER STRING
ST65
RECOGNITION IS ENDED

FIG.13


COMMODITY RECOGNITION PROCESSING
ST71
NO
COMMODITY IMAGE EXISTS
YES
DETECT FEATURE AMOUNT OF COMMODITY IMAGE
ST72
RETRIEVE COMMODITY RECOGNITION DICTIONARY FILE
ST73
ACQUIRE RECOGNITION DICTIONARY DATA
ST74
CALCULATE SIMILARITY DEGREE OF FEATURE AMOUNT
ST75
ST76
SIMILARITY DEGREE>K
NO
YES
STORE COMMODITY ID, COMMODITY NAME F AND SIMILARITY DEGREE
ST77
ST78
YES
UNPROCESSED DATA EXIST
NO
RECOGNITION IS ENDED

COMMODITY RECOGNITION APPARATUS AND COMMODITY RECOGNITION METHOD

CROSS-REFERENCE TO RELATED APPLICATION

This application is based upon and claims the benefit of priority from Japanese Patent Application No. 2012-193072, filed Sep. 3, 2012, the entire contents of which are incorporated herein by reference.

FIELD

Embodiments described herein relate to a commodity recognition apparatus and a commodity recognition method.

BACKGROUND

There is a technology in which the category of an object is recognized according to the similarity degree calculated such that the feature amount of the object is detected from the image data of the object photographed by an image capturing section and the feature amount detected is compared with the feature amount data registered in the recognition dictionary file to calculate the similarity degree of the object. Such a technology for recognizing the object included in an image is called as a generic object recognition. As to the technologies of the generic object recognition, various recognition technologies are disclosed in the following document.

Keiji Yanai "The Current State and Future Directions on Generic Object Recognition", Journal of Information Processing Society, Vol. 48, No. SIG16 [Search on Heisei 22 August 10], Internet <URL: http://mm.cs.uec.ac.jp/IPSJ-TCVIM-Yanai.pdf>

In addition, the technology carrying out the generic object recognition by area division of the image for each object is described in the following document.

Jamie Shotton etc, "Semantic Texton Forests for Image Categorization and Segmentation", [Search on Heisei 22 August 10], Internet <URL:http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.145.3036&rep=repl&type-pdf>

In recent years, for example, the generic object recognition technology is proposed to be applied to a recognition apparatus for recognizing a commodity, especially a commodity on which a barcode is not applied, such as vegetables, fruits and the like purchased by a customer in a checkout system (POS system) of a retail store. In this technology, the feature amount data for representing the surface information, such as, appearance shape, color (tint), pattern, and concave-convex (surface roughness) of a recognition target commodity in the form of parameters is stored in the recognition dictionary file. The commodity recognition apparatus detects the feature amount of appearance of a commodity from the image of the commodity captured by the image capturing section and compares the detected feature amount with the feature amount data of each commodity registered in the recognition dictionary file. And then the commodity recognition apparatus outputs a commodity similar in a feature amount to the recognized commodity as a candidate of recognized commodity.

In addition, in the same checkout system, a technology in which a specific character string is recognized from the image data of the object photographed by the image capturing section is also known.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an external view of a scanner apparatus according to a first embodiment;

FIG. **2** is a block diagram illustrating a constitution of main portion of the scanner apparatus;

FIG. **3** is a diagram illustrating a main data file stored in an auxiliary storage section of the scanner apparatus;

FIG. **4** is a schematic diagram illustrating the structure of dictionary data for each commodity stored in a commodity recognition dictionary file;

FIG. **5** is a diagram illustrating a main memory area formed in a RAM of the scanner apparatus;

FIG. **6** is a flowchart illustrating the main procedure of the information processing executed by a CPU of the scanner apparatus according to a commodity recognition program in the first embodiment;

FIG. **7** is a flowchart illustrating the main procedure of the information processing executed by a commodity recognition section of the scanner apparatus according to the first embodiment;

FIG. **8** is a flowchart illustrating the main procedure of the information processing executed by a character recognition section of the scanner apparatus according to the first embodiment;

FIG. **9** is a perspective view illustrating the front side of a tablet medicine;

FIG. **10** is a perspective view illustrating the back side of the tablet medicine;

FIG. **11** is a flowchart illustrating the main procedure of the information processing executed by the CPU of the scanner apparatus according to the commodity recognition program in a second embodiment;

FIG. **12** is a flowchart illustrating the main procedure of the information processing executed by the commodity recognition section of the scanner apparatus according to the second embodiment;

FIG. **13** is a flowchart illustrating the main procedure of the information processing executed by the character recognition section of the scanner apparatus according to the second embodiment.

DETAILED DESCRIPTION

In accordance with one embodiment, a commodity recognition apparatus includes a feature amount detection module, a commodity candidate extraction module, a character recognition module and a commodity determination module. The feature amount detection module detects the appearance feature amount of a commodity included in an image captured by an image capturing unit. The commodity candidate extraction module extracts the candidate of the commodity included in the image by comparing the data of the appearance feature amount detected by the feature amount detection module with feature amount data in a recognition dictionary file for storing the feature amount data representing the surface information of a commodity for each commodity of a recognition target. The character recognition module recognizes a character string included in the image captured by the image capturing unit. The commodity determination module determines a commodity of the recognition target according to the character string recognized by the character recognition module and the candidate of the commodity extracted by the commodity candidate extraction module.

Hereinafter, one embodiment of the commodity recognition apparatus is described with reference to the accompanying drawings. In the present embodiment, a scanner apparatus **1** in an ethical pharmacy dealing in medical supplies has a function as a commodity recognition apparatus.

A First Embodiment

FIG. **1** is an external view of the scanner apparatus **1**. The scanner apparatus **1** includes a thin rectangular housing **11**

vertically arranged on a counter **2** as a main body. A touch panel **12** is arranged at the top of the housing **11** as an operation & display section.

A CCD camera **13** is installed in the housing **11** as an image capturing unit. A rectangular-shaped reading window **14** is formed at the front of the housing **11**. The CCD camera **13** comprises a CCD (Charge Coupled Device) image capturing element as an area image sensor and a drive circuit thereof, and an image capturing lens for focusing the image of an image capturing area on the CCD image capturing element. The image capturing area refers to an area of a frame image focused on the area of the CCD image capturing element through the image capturing lens from the reading window **14**. The CCD camera **13** outputs the image of the image capturing area focused on the CCD image capturing element through the image capturing lens.

FIG. **2** is a block diagram illustrating a constitution of main portion of the scanner apparatus **1**. The scanner apparatus **1** is a computer device comprising a CPU (Central Processing Unit) **21** constituting a main control section, a ROM (Read Only Memory) **22** and a RAM (Random Access Memory) **23** constituting a main storage section. The CPU **21**, the ROM **22** and the RAM **23** are connected with a bus line BL such as an address bus line, a data bus line and the like. In addition, an auxiliary storage section **24**, a communication interface **25**, a camera controller **26**, a touch panel controller **27**, a commodity recognition section **28** and a character recognition section **29** are connected with the bus line BL mentioned above.

The auxiliary storage section **24**, for example, is a HDD (Hard Disk Drive) apparatus or a SSD (Solid State Drive) apparatus. As shown in FIG. **3**, the auxiliary storage section **24** stores a data file such as a commodity recognition dictionary file **31**, a character recognition dictionary file **32** and the like besides storing various programs.

The commodity recognition dictionary file **31** stores the feature amount data representing the surface information such as the appearance shape, tint, pattern, and concave-convex and the like of a commodity in the form of parameters in association with the recognition information for each commodity serving as a recognition target. The character recognition dictionary file **32** stores character string feature data digitalizing the feature of the character string for each character string being a recognition target. The commodity name of the commodity being a recognition target is included in the character string.

The communication interface **25** carries out a data communication with an electronic device, e.g., a POS (Point Of Sales) terminal, connected through a communication line. The camera controller **26** drives the CCD camera **13**, and acquires the image data captured by the CCD camera **13**. The touch panel controller **27** displays an image on the screen of the touch panel **12**. In addition, the touch panel controller **27** detects a touch position coordinate on the screen according to the signal of a touch sensor overlaid on the screen.

The commodity recognition section **28** recognizes the commodity included in the captured image by detecting the appearance feature amount of the commodity included in the captured image from the image data captured by the CCD camera **13** according to the program executed under the control of the CPU **21**, and comparing the detected appearance feature amount with the feature amount data in the commodity recognition dictionary file **31**. The character recognition section **29** recognizes the character string included in the captured image by detecting the feature of each character included in the captured image from the image data captured by the CCD camera **13** according to the program executed under the control of the CPU **21**, and comparing the detected feature with the character string feature data in the character recognition dictionary file **32**.

FIG. **4** is a schematic diagram illustrating the structure of a dictionary data for each commodity stored in the commodity recognition dictionary file **31**. As shown in FIG. **4**, in the commodity recognition dictionary file **31**, a character recognition flag F and a plurality of feature amount data are stored in association with a commodity ID and a commodity name for recognizing the commodity for each commodity of a recognition target. The character recognition flag F is set to "1", if the commodity recognized by the corresponding commodity ID needs a character recognition, or reset to "0" if the commodity recognized by the corresponding commodity ID does not need the character recognition. For example, as medical supplies, commodities which hardly have a difference in appearance thoseof but respectively have different medicine names need the character recognition, and therefore, the character recognition flag F is set to "1". The commodity recognition dictionary file **31** functions as a flag storage section storing the flag for distinguishing whether or not the commodity needs the character recognition for each commodity.

The feature amount data represent the appearance feature amount serving as surface information (appearance shape, tint, pattern, and concave-convex and the like) of the commodity discriminated by the corresponding commodity ID in the form of parameters including a plurality of bit strings, and the feature amount data 1–N for one commodity which is observed from various directions are respectively stored. The number N of feature amount data for one commodity is not fixed. In addition, the number N of feature amount data is different from one another according to commodity.

FIG. **5** is a schematic diagram illustrating a main memory area formed in the RAM **23**. As shown in FIG. **5**, the scanner apparatus **1** forms an image data memory **51**, a dictionary data memory **52**, a similarity degree determination table **53** and a correspondence rate determination table **54** in the RAM **23**. The image data memory **51** temporarily stores the frame image of the image capturing area captured by the CCD camera **13**. The dictionary data memory **52** temporarily stores the dictionary data for each commodity read out of the commodity recognition dictionary file **31**. The similarity degree determination table **53** stores a plurality of recodes including each item data of a commodity ID, a commodity name, a character recognition flag F and a similarity degree as one record. The correspondence rate determination table **54** stores a plurality of recodes including each item data of a character string, a commodity name and a correspondence rate as one record.

FIG. **6** is a flowchart illustrating the main procedure of the information processing executed by the CPU **21** according to a commodity recognition program stored in the ROM **22** serving as a program storage section or the auxiliary storage section **24**. Namely, when the commodity recognition program is started, the CPU **21** outputs an image capturing on-signal to the camera controller **26** (ACT ST**1**). The camera controller **26** starts the CCD camera **13** according to the image capturing on-signal. Thus, the CCD camera **13** starts photographing of the image capturing area. The frame images of the image capturing area captured by the CCD camera **13** are acquired in sequence by the camera controller **26**, and are stored in an image buffer.

After outputting the image capturing on-signal, the CPU **21** instructs the commodity recognition section **28** to execute commodity recognition processing (ACT ST**2**). Upon receiv-

ing the instruction, the commodity recognition section **28** starts the commodity recognition processing illustrated in FIG. **7**.

First, the commodity recognition section **28** acquires the frame image of the image capturing area from the image buffer. Then, the commodity recognition section **28** writes the data of the frame image in the image data memory **51** (ACT ST**21**).

Next, the commodity recognition section **28** confirms whether or not the frame image stored in the image data memory **51** includes a commodity image (ACT ST**22**). Specifically, the commodity recognition section **28** extracts a contour line and the like from the binary image of the frame image. The commodity recognition section **28** tries to extract the contour of an object imaged in the frame image. If the contour of the object is extracted, the commodity recognition section **28** regards the image in the contour as a commodity image.

If the commodity image is not included in the frame image (NO in ACT ST**22**), the commodity recognition section **28** acquires a new (next) frame image from the image buffer, and overwrites the new frame image in the image data memory **51** (ACT ST**21**). The commodity recognition section **28** further confirms whether or not the frame image stored in the image data memory **51** includes a commodity image (ACT ST**22**).

If the commodity image is included in the frame image (YES in ACT ST**22**), the commodity recognition section **28** detects the feature amount on appearance (appearance feature amount) such as the shape, tint, pattern, and concave-convex and the like of the commodity from the image in the contour which is regarded as a commodity (ACT ST**23**: feature amount detection module).

After the detection of the appearance feature amount is ended, the commodity recognition section **28** retrieves the commodity recognition dictionary file **31** (ACT ST**24**). Afterwards, the commodity recognition section **28** acquires the unprocessed dictionary data for each commodity (the commodity ID, the commodity name, the character recognition flag F, the plurality of feature amount data) from the commodity recognition dictionary file **31**, and writes it in the dictionary data memory **52** (ACT ST**25**).

The commodity recognition section **28** calculates the similarity degree indicating how similar are the data of the appearance feature amount detected in the processing in ACT ST**23** to the feature amount data in the dictionary data for each commodity written in the dictionary data memory **52** (ACT ST**26**). The greater the similarity degree is, the higher the similarity rate is. In the present embodiment, the upper limit of the similarity degree is set to "100". The similarity degree may be a value acquired based on the feature amount of the image captured by the image capturing unit (CCD camera **13** in the present embodiment) and the feature amount stored in the dictionary. For example, the similarity degree includes a correspondence degree (correspondence rate) denoting the degree of correspondence or a correlation value denoting the degree of correlation, and the like.

When the similarity degree is calculated, the commodity recognition section **28** confirms whether or not the similarity degree calculated is higher than a specified reference threshold value K (ACT ST**27**). The reference threshold value K is the lower limit value of the similarity degree of the commodity which should be retained as a registration commodity candidate. If the upper limit value of the similarity degree is set to "100" as described above, the reference threshold value K, for example, is set to "20", which is one fifth of the upper limit value of the similarity degree.

If the similarity degree is lower than the reference threshold value K (NO in ACT ST**27**), the commodity having the dictionary data for each commodity written in the dictionary data memory **52** is not the commodity retained as a registration commodity candidate. In such a case, the commodity recognition section **28** proceeds to the processing in ACT ST**29**.

If the similarity degree is higher than the reference threshold value K (YES in ACT ST**27**), the commodity having the dictionary data for each commodity written in the dictionary data memory **52** is the commodity retained as a registration commodity candidate. In such a case, the commodity recognition section **28** adds the commodity ID, the commodity name and the character recognition flag F in the dictionary data memory **52** and the similarity degree calculated in the processing in ACT ST**26** to the similarity degree determination table **53** as a record of the registration commodity candidate (ACT ST**28**: commodity candidate extraction module). Afterwards, the commodity recognition section **28** proceeds to the processing in ACT ST**29**.

In ACT ST**29**, the commodity recognition section **28** confirms whether or not there is unprocessed dictionary data for each commodity in the commodity recognition dictionary file **31**. If the unprocessed dictionary data for each commodity exists in the commodity recognition dictionary file **31** (YES in ACT ST**29**), the commodity recognition section **28** returns to the processing in ACT ST**25**. Namely, the commodity recognition section **28** executes the processing in ACT ST**26**-ACT ST**28** after acquiring the unprocessed dictionary data for each commodity from the commodity recognition dictionary file **31** and overwriting it in the dictionary data memory **52**.

In this way, after the processing in ACT ST**25**-ACT ST**28** is executed for all the dictionary data for each commodity stored in the commodity recognition dictionary file **31** (NO in ACT ST**29**), the commodity recognition section **28** notifies the end of the commodity recognition processing to the CPU **21**.

The CPU **21** waits for the notice that the commodity recognition processing is ended (ACT ST**3**). Upon receiving the notice that the commodity recognition processing is ended (YES in ACT ST**3**), the CPU **21** confirms whether or not there is only one similarity degree higher than a determination threshold value A in the similarity degree of the registration commodity candidate stored in the similarity degree determination table **53** (ACT ST**4**). The determination threshold value A is a value of the similarity degree which allows that the commodity extracted as a registration commodity candidate in the commodity recognition processing is determined as the commodity included in the image data in the image data memory **51**. The determination threshold value A is set to "75", for example, that is relatively close to the upper limit value in a case that the upper limit value of the similarity degree is set to "100" as described above.

If only one commodity of which the similarity degree is higher than the determination threshold value A exists in the registration commodity candidate (YES in ACT ST**4**), the commodity is determined as a registration commodity. The CPU **21** displays the commodity name and the like of the determined commodity on the touch panel **12** (ACT ST**14**).

If no commodity of which the similarity degree is higher than the determination threshold value A exists or more than two commodities of which each similarity degree is higher than the determination threshold value A exist (NO in ACT ST**4**), the registration commodity is not determined. In such a case, the CPU **21** determines whether or not the character

recognition processing is needed with reference to the similarity degree determination table **53** (ACT ST**5**: determination module).

If at least one record in which the character recognition flag F is set to "1" exists in the similarity degree determination table **53**, the character recognition processing is needed. On the contrary, if the record in which no character recognition flag F is set to "1" exists, the character recognition processing is not needed. If the character recognition processing is not needed (NO in ACT ST**5**), the CPU **21** proceeds to the processing of determining the registration commodity from the registration commodity candidate recognized in the commodity recognition processing.

In a case that the character recognition processing is needed (YES in ACT ST**5**), the CPU **21** instructs the character recognition section **29** to execute the character recognition processing (ACT ST**6**). Upon receiving the instruction, the character recognition section **29** starts the character recognition processing illustrated in FIG. **8**.

First, the character recognition section **29** cuts out an area including character from the frame image in the image data memory **51** (ACT ST**31**). Afterwards, the character recognition section **29** detects the feature of the character for each character area, and compares the feature of the detected character with the character string feature data registered in the character recognition dictionary file **32** to recognize the character string in the character area (ACT ST**32**: character recognition module).

The character recognition section **29** determines whether or not the character string can be recognized (ACT ST**33**). If none of the character strings can be recognized (NO in ACT ST**33**), the character recognition section **29** notifies the end of the character recognition processing to the CPU **21**.

If at least one character string is recognized (YES in ACT ST**33**), the character recognition section **29** stores all the recognized character strings in a character string area of the correspondence rate determination table **54** in sequence (ACT ST**34**). Afterwards, the character recognition section **29** notifies the CPU **21** of the end of the character recognition processing.

The CPU **21** waits for the notice that the character recognition processing is ended (ACT ST**7**). Upon receiving the notice that the character recognition processing is ended (YES in ACT ST**7**), the CPU **21** confirms whether or not the character string data are stored in the character string area of the correspondence rate determination table **54** (ACT ST**8**). If the character string data are not stored in the character string area of the correspondence rate determination table **54** (NO in ACT ST**8**), the CPU **21** displays a message instructing that the surface on which the commodity name is printed is held over the reading window **14** on the touch panel **12** to notify a user of it (ACT ST**9**: notification module). Afterwards, the CPU **21** executes the commodity recognition processing in ACT ST**2** again.

If the character string data are stored in the character string area of the correspondence rate determination table **54** (YES in ACT ST**8**), the CPU **21** calculates the correspondence rate for each character string with the commodity name of the registration commodity candidate stored in the similarity degree determination table **53**. The CPU **21** finds out the commodity name with the highest correspondence rate for each character string, and stores the commodity name and the correspondence rate in the correspondence rate determination table **54** in association with the character string (ACT ST**10**).

Afterwards, the CPU **21** detects the highest correspondence rate from the correspondence rate determination table **54**. Then, the CPU **21** confirms whether or not the highest correspondence rate is higher than an available threshold value B (ACT ST**11**). The available threshold value B is a value of the correspondence rate which allows determination of the commodity name even though the corresponding character string lacks a part of the commodity name. The available threshold value B is set to "75", for example.

If the highest correspondence rate is lower than the available threshold value B (NO in ACT ST**11**), the commodity name is not determined. In this case, the CPU **21** executes the commodity recognition processing in ACT ST**2** again.

If the highest correspondence rate is equal to or higher than the available threshold value B (YES in ACT ST**11**), the commodity name stored in the correspondence rate determination table **54** corresponding to the highest correspondence rate is determined to be the commodity name estimated according to the character string recognized from the frame image in the image data memory **51**. In this case, the CPU **21** selects the commodity name corresponding to the highest correspondence rate from the correspondence rate determination table **54** (ACT ST**12**) Afterwards, the CPU **21** retrieves the similarity degree determination table **53** with the commodity name, and confirms whether or not the similarity degree corresponding to the commodity name is equal to or higher than a quasi determination threshold value C (ACT ST**13**). The quasi determination threshold value C is a value of the similarity degree which allows that the commodity extracted as a registration commodity candidate in the commodity recognition processing is determined as the commodity included in the image data in the image data memory **51** according to the commodity name recognized in the character recognition processing. The quasi determination threshold value C is set to a value lower than the determination threshold value A, for example, "50".

If the similarity degree for the commodity of the commodity name selected from the correspondence rate determination table **54** is lower than the quasi determination threshold value C (NO in ACT ST**13**), the registration commodity is not determined as the commodity of this commodity name. In this case, the CPU **21** executes the commodity recognition processing in ACT ST**2** again.

If the similarity degree for the commodity of the commodity name selected from the correspondence rate determination table **54** is equal to or higher than the quasi determination threshold value C (YES in ACT ST**13**), the registration commodity is determined as the commodity of this commodity name. The CPU **21** displays the commodity name and the like of the determined commodity on the touch panel **12** (ACT ST**14**).

FIG. **9** is a perspective view of the front side of a tablet medicine **60** which is an example of a commodity recognized by the scanner apparatus **1**. FIG. **10** is a perspective view of the back side of the tablet medicine **60**. The tablet medicine **60** is printed with the medicine name "ABODE" on the back side. However, since the medicine name "ABCDE" is randomly printed, as shown in FIG. **10**, the character strings "CDE", "AB", "DE" or "ABC" lacking a part of the medicine name "ABCDE" also exists.

In the commodity recognition dictionary file **31**, the feature amount data 1−N obtained when the front side and back side of the tablet medicine **60** are observed at various angles are stored as a dictionary data relating to this medicine **60**. In addition, the character recognition flag F is set to "1".

Assuming that a user holds the front side surface of the tablet medicine **60** over the reading window **14** of the scanner apparatus **1**. In this state, the commodity recognition processing is executed on the image of the front side surface of the tablet medicine **60** in the scanner apparatus **1**. As a result, if

there are more than two registration commodity candidates, including tablet medicine **60**, of which the similarity degrees are higher than the determination threshold value A. In such a case, the registration commodity is not determined by the scanner apparatus **1**.

The tablet medicine **60** of which the character recognition flag F is set to "1" is included in the registration commodity candidates. Therefore, in the scanner apparatus **1**, the character recognition processing is executed subsequently. However, the character cannot be recognized according to the image of the front side surface of the tablet medicine **60**. Therefore, the message instructing that the surface on which the commodity name is printed is held over the reading window **14** is displayed on the touch panel **12**.

The user holds the back side surface of the tablet medicine **60** over the reading window **14** of the scanner apparatus **1**. Thus, in the scanner apparatus **1**, the commodity recognition processing is executed on the image of the back side surface of the tablet medicine **60**. As a result, if there also are more than two registration commodity candidates, including the tablet medicine **60**, of which the similarity degrees are higher than the determination threshold value A. In such a case, in the scanner apparatus **1**, the registration commodity is not also determined.

The registration commodity candidates include the tablet medicine **60** of which the character recognition flag F is set to "1". Therefore, in the scanner apparatus **1**, the character recognition processing is executed subsequently. At this time, the character strings "ODE", "AB", "DE", "ABC" and "ABODE" are recognized. At the moment, in the similarity degree determination table **53**, the data of the tablet medicine **60**, namely the data including the medicine name "ABODE", are registered. In addition, it is assumed that the commodity names completely consistent with the character strings "CDE", "AB", "DE" and "ABC" lacking a part of the medicine name "ABODE" do not exist. In such a condition, the correspondence rate of the character strings "ODE" and "ABC" with the medicine name "ABODE" is 60%, the correspondence rate of the character strings "AB" and "DE" with the medicine name "ABODE" is 40%, and the correspondence rate of the character string "ABODE" with the medicine name "ABODE" is 100%. Therefore, the highest correspondence rate is 100%, and moreover, is higher than the available threshold value B. Therefore, the medicine name "ABODE" is selected in the scanner apparatus **1**. Moreover, since the similarity degree of the record including the medicine name "ABODE" is higher than the determination threshold value A, namely, is higher than the quasi determination threshold value C, the tablet medicine **60** with the medicine name "ABCDE" is determined as a registration commodity in the scanner apparatus **1**.

According to the present embodiment, by simultaneously using the commodity recognition processing and the character recognition processing, a high recognition rate can be achieved in the determination of the registration commodity even in the case that a plurality of commodities hardly having any difference on appearance, for example, medical supplies, are included as a recognition target commodity. In addition, so long as a difference exists on the appearance of the commodity to be recognized, the registration commodity can also be determined with a quite high recognition rate even though the commodity name is the same.

A Second Embodiment

In the first embodiment, as shown in FIG. **6**, the commodity recognition processing is carried out first, and the character recognition processing is carried out subsequently. However, the same effect as the first embodiment can be also achieved even though the character recognition processing is executed first and the commodity recognition processing is executed subsequently.

Hereinafter, the second embodiment in which the character recognition processing is executed first and the commodity recognition processing is executed subsequently is described with reference to FIG. **11** to FIG. **13**. In the second embodiment also, similar to the first embodiment, the scanner apparatus **1** in the ethical dispensing pharmacy dealing in medical supplies have the function as the commodity recognition apparatus, and constitution of the scanner apparatus **1** and the data structures of the commodity recognition dictionary file **31** and the character recognition dictionary file **32** are common with those of the first embodiment. Therefore, the same numerals are applied to similar elements and the detailed descriptions thereof are omitted.

FIG. **11** is a flowchart illustrating the main procedure of the information processing executed by the CPU **21** according to the commodity recognition program in the second embodiment. Namely, when the commodity recognition program is started, the CPU **21** outputs the image capturing on-signal to the camera controller **26** (ACT ST**41**). Next, the CPU **21** instructs the character recognition section **29** to execute the character recognition processing (ACT ST**42**). Upon receiving the instruction, the character recognition section **29** starts the character recognition processing illustrated in FIG. **12**.

First, the character recognition section **29** acquires the frame image of the image capturing area from the image buffer. Then, the character recognition section **29** writes the data of the frame image in the image data memory **51** (ACT ST**61**). Next, the character recognition section **29** cuts out the area including the character from the frame image in the image data memory **51** (ACT ST**62**). The character recognition section **29** detects the feature of the character for each character area, and compares the feature with the character string feature data registered in the character recognition dictionary file **32** to recognize the character string in the character area (ACT ST**63**: character recognition module).

The character recognition section **29** determines whether or not the character string can be recognized (ACT ST**64**). If none of the character strings can be recognized (NO in ACT ST**64**), the character recognition section **29** notifies the end of the character recognition processing to the CPU **21**.

If at least one character string is recognized (YES in ACT ST**64**), the character recognition section **29** stores all the recognized character strings in the character string area of the correspondence rate determination table **54** in sequence (ACT ST**65**). Afterwards, the character recognition section **29** notifies the end of the character recognition processing to the CPUI **21**.

The CPU **21** waits for the notice that the character recognition processing is ended (ACT ST**43**). Upon receiving the notice that the character recognition processing is ended (YES in ACT ST**43**), the CPU **21** instructs the commodity recognition section **28** to execute the commodity recognition processing (ACT ST**44**). Upon receiving the instruction, the commodity recognition section **28** starts the commodity recognition processing in the procedures in ACT ST**71**-ACT ST**78** illustrated in FIG. **13**. The commodity recognition processing is the same as that in the procedures in ACT ST**22**-ACT ST**29** in the first embodiment. Namely, after extracting the commodity image from the frame image stored in the image data memory **51** (YES in ACT ST**71**), the commodity recognition section **28** detects the feature amount on appearance (appearance feature amount) such as the shape, surface

tint, pattern, concave-convex and the like of the commodity from the image in the contour regarded as the image of the commodity (ACT ST**72**: feature amount detection module). Next, the commodity recognition section **28** calculates the similarity degree for each commodity representing how similar is the data of the appearance feature amount to the feature amount data of the dictionary data for each commodity stored in the commodity recognition dictionary file **31** (ACT ST**73**-ACT ST**75**), and adds the commodity ID, the commodity name, the character recognition flag F and the similarity degree of the commodity of which the similarity degree is equal to or higher than the reference threshold value K to the similarity degree determination table **53** as a record of the registration commodity candidate (ACT ST**76**, ACT ST**77**: commodity candidate extraction module).

After the processing in ACT ST**74**-ACT ST**77** is executed for all the dictionary data for each commodity (NO in ACT ST**78**), the commodity recognition section **28** notifies the end of the commodity recognition processing to the CPU **21**.

The CPU **21** waits for the notice that the commodity recognition processing is ended (ACT ST**45**). Upon receiving the notice that the commodity recognition processing is ended (YES in ACT ST**45**), the CPU **21** confirms whether or not only one similarity degree equal to or higher than the determination threshold value A exists in the similarity degrees of the registration commodity candidates stored in the similarity degree determination table **53** (ACT ST**46**).

If only one commodity of which the similarity degree is equal to or higher than the determination threshold value A exists in the registration commodity candidates (YES in ACT ST**46**), the commodity is determined as a registration commodity. The CPU **21** displays the commodity name and the like of the determined commodity on the touch panel **12** (ACT ST**54**).

If the commodity of which the similarity degree is equal to or higher than the determination threshold value A does not exist or more than two commodities of which the similarity degrees are equal to or higher than the determination threshold value A exist (NO in ACT ST**46**), the registration commodity is not determined. In such a condition, the CPU **21** determines whether or not the character recognition processing is needed with reference to the similarity degree determination table **53** (ACT ST**47**: determination module). If the character recognition processing is not needed (NO in ACT ST**47**), the CPU **21** proceeds to the processing of determining the registration commodity from the registration commodity candidate recognized in the commodity recognition processing.

If the character recognition processing is needed (YES in ACT ST**47**), the CPU **21** confirms whether or not the character string data are stored in the character string area of the correspondence rate determination table **54** (ACT ST**48**). If the character string data are not stored in the character string area of the correspondence rate determination table **54** (NO in ACT ST**48**), the CPU **21** displays the message instructing that the surface on which the commodity name is printed is held over the reading window **14** on the touch panel **12** to notify it to the user (ACT ST**49**: notification module). Afterwards, the CPU **21** executes the commodity recognition processing of ACT ST**42** again.

If the character string data are stored in the character string area of the correspondence rate determination table **54** (YES in ACT ST**48**), the CPU **21** calculates the correspondence rate for each character string with the commodity name of the registration commodity candidate stored in the similarity degree determination table **53**. Afterwards, the CPU **21** finds out the commodity name with the highest correspondence rate for each character string, and stores the commodity name and the correspondence rate in the correspondence rate determination table **54** in association with the character string (ACT ST**50**).

Afterwards, the CPU **21** detects the highest correspondence rate from the correspondence rate determination table **54**. Then, the CPU **21** confirms whether or not the highest correspondence rate is equal to or higher than the available threshold value B (ACT ST**51**). If the highest correspondence rate is lower than the available threshold value B (NO in ACT ST**51**), the CPU **21** executes the commodity recognition processing in ACT ST**42** again.

If the highest correspondence rage is equal to or higher than the available threshold value B (YES in ACT ST**51**), the CPU **21** selects the commodity name corresponding to the highest correspondence rate from the correspondence rate determination table **54** (ACT ST**52**). The CPU **21** retrieves the similarity degree determination table **53** with the commodity name to confirm whether or not the similarity degree corresponding to the commodity name is equal to or higher than the quasi determination threshold value C (ACT ST**53**). If the similarity degree is lower than the quasi determination threshold value C (NO in ACT ST**53**), the CPU **21** executes the commodity recognition processing in ACT ST**42** again.

If the similarity degree corresponding to the commodity of the commodity name selected from the correspondence rate determination table **54** is equal to or higher than the quasi determination threshold value C (YES in ACT ST**53**), the registration commodity is determined as a commodity of this commodity name. The CPU **21** displays the commodity name and the like of the determined commodity on the touch panel **12** (ACT ST**54**).

In the second embodiment with such procedures also, the effect the same as that of the first embodiment can be also achieved. However, in the second embodiment, the character recognition processing is certainly executed, but in the first embodiment, the character recognition processing is executed only in the case that the character recognition is confirmed to be needed according to the status of the character recognition flag F, and therefore, compared with the second embodiment, the processing load in the first embodiment is small.

The present embodiment is not limited to the embodiments mentioned above.

For example, in the embodiments mentioned above, the character string recognized in the character recognition processing is determined as a commodity name, but besides the commodity name, for example, a maker name can be also recognized. In addition, the determination threshold value A, the available threshold value B, the quasi determination threshold value C and the reference threshold value K exemplified in the embodiments mentioned above are not limited to the values of the embodiments, and of course, suitable values can be set according to a purpose of use, respectively.

The recognition target in the present embodiments is described on the medical supplies as an example, but is not limited to that. For example, separately packaged food (for example, sweets such as a candy and the like), separately packaged daily necessaries (for example, a battery and the like), or industrial goods such as a screw, a bolt and the like, can be also used as a recognition target.

In addition, the embodiment shows the case that a single scanner apparatus **1** has the function of the commodity recognition apparatus, but a checkout system constituted with the scanner apparatus **1** and the POS terminal can also has the function of the commodity recognition apparatus. In such a case, the commodity recognition dictionary file **31** and the

character recognition dictionary file **32** can be also provided to the POS terminal instead of the scanner apparatus **1**. Alternatively, the dictionary file mentioned above can be also provided in a store server acting as a higher level server of the POS terminal.

In addition, in the embodiment, a control method realizing the function of the present invention is prerecorded in the method storage section inside the apparatus. However, it is not limited to this. The same method can be also downloaded to the apparatus from a network. Alternatively, the same method recorded in a recording medium can be also installed in the apparatus. So long as the recording medium is an apparatus which can store the method such as a CD-ROM, a memory card and the like, and furthermore, is readable to an apparatus, its form can be random. In addition, the function acquired by the installation and the downloading of the method can be also realized by cooperating an OS (Operating System) and the like inside the apparatus. Moreover, the method of the present embodiment can be also incorporated in a mobile phone with a communication function and a portable information terminal such as a so-called PDA to realize the function.

While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the invention. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the invention. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the invention.

What is claimed is:

1. A commodity recognition apparatus, comprising:

a feature amount detection module configured to detect an appearance feature amount of a commodity included in an image captured by an image capturing unit;

a commodity candidate extraction module configured to extract a candidate of the commodity included in the image by comparing the data of the appearance feature amount detected by the feature amount detection module with the feature amount data in a recognition dictionary file storing feature amount data representing the surface information of a commodity for each commodity which is a recognition target;

a determination module configured to determine whether or not character recognition is required from the candidate of the commodity extracted as the candidate by the commodity candidate extraction module;

a character recognition module configured to recognize a character string included in the image captured by the image capturing unit, if the determination module determines that the character recognition is required; and

a commodity determination module configured to determine a commodity of a recognition target according to the character string recognized by the character recognition module and the candidate of the commodity extracted by the commodity candidate extraction module.

2. The commodity recognition apparatus according to claim **1**, wherein

the commodity determination module determines, as a commodity of the recognition target, the commodity including the character string recognized by the character recognition module in its commodity name from the candidate of the commodity extracted by the commodity candidate extraction module.

3. The commodity recognition apparatus according to claim **1**, further comprising:

a flag storage section configured to store a flag for distinguishing whether or not the character recognition is required for each commodity of the recognition target, wherein

the determination module is configured to determine whether or not the character recognition is required according to the flag for the commodity extracted as the candidate by the commodity candidate extraction module.

4. The commodity recognition apparatus according to claim **3**, further comprising:

a notification unit configured to notify a result of the character recognition if the result of executing the character recognition module is that the character string cannot be recognized from the image captured by the image capturing unit.

5. The commodity recognition apparatus according to claim **3**,

wherein

the character recognition module is executed if the determination module determines that the character recognition is required for the commodity.

6. A commodity recognition method, including:

detecting an appearance feature amount of a commodity included in an image captured;

comparing the data of the detected appearance feature amount with a stored feature amount data representing surface information of a commodity for each commodity of a recognition target to extract a candidate of the commodity included in the image captured;

determining whether or not character recognition is required from the candidate of the commodity extracted as the candidate;

recognizing a character string included in the image captured, if it is determined that the character recognition is required; and

determining a commodity of the recognition target according to the recognized character string and the candidate of the extracted commodity.

7. A commodity recognition apparatus, comprising:

an interface which captures an image captured by a camera; and

a processor, the processor executing the following:

detecting an appearance feature amount of a commodity included in the image captured by the camera;

comparing data of the appearance feature amount of the commodity with feature amount data in a recognition dictionary file storing feature amount data representing surface information of a commodity for each commodity which is a recognition target;

determining whether or not the character recognition is required from the candidate of the commodity extracted as the candidate;

recognizing a character string included in the image captured by the camera, if the determination module determines that the character recognition is required; and

determining a commodity of a recognition target from the candidate of the commodity according to the character string recognized.

8. The commodity recognition apparatus according to claim 7, wherein

the processor determines, as a commodity of the recognition target, the commodity including the character string recognized in its commodity name from the candidate of the commodity.

9. The commodity recognition apparatus according to claim 7, further comprising:

a memory configured to store a flag for distinguishing whether or not the character recognition is required for each commodity of the recognition target, wherein

the processor determines whether or not the character recognition is required according to the flag for the commodity extracted as the candidate.

10. The commodity recognition apparatus according to claim 9, wherein

the processor notifies a result of the character recognition if the result of executing the character recognition module is that the character string cannot be recognized.

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